

CHAPTER 7

Functions And Relationships

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April 20, 2021

1 FUNCTIONS AND RELATIONSHIPS

NOTE

Output numbers are numbers that you obtain when you apply the rule to the input numbers.

2. Write down the output numbers that will be obtained when the formula $50 - 5x$ is applied to set B.

•1. Complete the following table for set A:

Input numbers	1	2	3	4	5	6	7	8	9
Values of $50-5x$									

2. Complete the following table for the set B:

Input numbers	20	30	40	50	60	70	80	90	
Values of $50-5x$									

•In this question your set of input numbers will be the even numbers 2; 4; 6; 8; 10; ...

1. What will all the output numbers be if the rule $2n + 1$ is applied to the set of even numbers? Write a list.
2. What will the output numbers be if the rule $2n - 1$ is applied?
3. What will the output numbers be if the rule $2n + 5$ is applied?
4. What will the output numbers be if the rule $3n + 1$ is applied?

1. What kind of output numbers will be obtained by applying the rule $x - 1000$ to natural numbers smaller than 1 000?
2. What kind of output numbers will be obtained by applying the rule $\frac{x}{10} + 10$ to natural numbers smaller than 10?
3. If you use the rule $30x + 2$, and use input numbers that are positive fractions with denominators 2, 3 and 5, what kind of output numbers will you obtain?

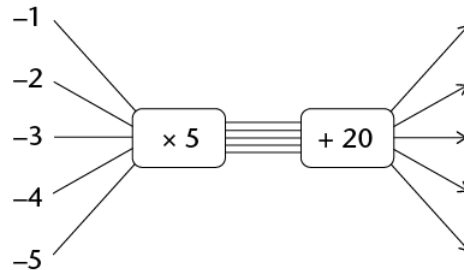
A quantity that changes is called a **variable quantity** or just a **variable**.

If one variable quantity is influenced by another, we say there is a **relationship** between the two variables. You can sometimes work out which number is linked to a specific value of the other variable.

The output number can also be called the output value, or the value of the expression, which is $10x + 5$ in this case.

A relationship between two variables in which there is only one output number for each input number, is called a **function**.

- With a table that shows some values of the two variables. A table shows clearly which value of the output variable corresponds to each particular value of the input variable.
- A flow diagram, which shows what calculations are to be done to calculate the output number that corresponds to a given input variable.
- A formula, which also describes what calculations are to be done to calculate the output number that corresponds to a given input variable.
- A graph.
- Complete the flow diagram:



A completed flow diagram shows two kinds of information:

- It shows what calculations are done to produce the output numbers.
- It shows which output number is connected to which input number.
- Each input number is multiplied by 5, then 20 is added, to produce the output numbers
- Which output numbers correspond to which input numbers.

The output numbers of a function are also called **function values**. Hence the formula can also be written as *function value* = $5x + 20$.

2 EXERCISES

2.1 Exercise 1

In this activity you will do some calculations with:

- Set A: the natural numbers smaller than 10: i.e. 1, 2, 3, 4, 5, 6, 7, 8 and 9
- Set B: multiples of 10 that are bigger than 10 but smaller than 100: i.e. 20, 30, 40, 50, 60, 70, 80 and 90

1. You are going to choose a number, multiply it by 5, and subtract the answer 50.
 - (a) Choose any number from set A and do the above calculations
 - (b) Choose any number from set n and do the above calculations
2.
 - (a) Write down all the different output numbers that will be obtained when the calculations $50 - 5x$ are on the different numbers in the set A.
 - (b) Write down the output numbers that will be obtained when the formula $50 - 5x$ is applied to the set B.
3.
 - (a) Copy and complete the following table for set A :

Input Numbers	1	2	3	4	5	6	7	8	9
Values of $50-5x$									

- (b) Copy and complete the following table for set B :

Input Numbers	20	30	40	50	60	70	80	90
Values of $50-5x$								

4. In this question your set of output numbers will be even numbers: 2; 4; 6; 8; 10; ...
 - (a) What will all the output numbers be if the rule $2n + 1$ is applied to the set of even numbers? Write a list.
 - (b) What will all the output numbers be if the rule $2n - 1$ is applied?
 - (c) What will all the output numbers be if the rule $2n + 5$ is applied?
 - (d) What will all the output numbers be if the rule $3n + 1$ is applied?
5.
 - (a) What kind of output numbers will be obtained by applying the rule $x - 1\ 000$ to natural numbers smaller than 1 000?

- (b) What kind of natural numbers will be obtained by applying the rule $\frac{x}{10} + 10$ to natural numbers smaller than 10?
- (c) If you use the rule $30x + 2$, and use the input numbers that are positive fractions with denominators 2, 3, and 5, what kind of output numbers will you obtain?

2.2 Exercise 2

1. Copy and complete the following flow diagram

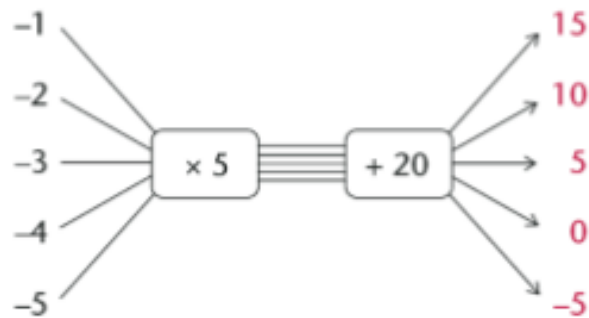


Figure 1:

2. Copy and complete the following table for set A :

Input Values	-1	-2	-3	-4	5
Function Values					

3. Draw a graph of the function $5x + 20$ where $-6 \geq x \leq 2$.
4. A graph of a certain function is shown. Copy and complete the table for this function:

Input numbers					
Function values					

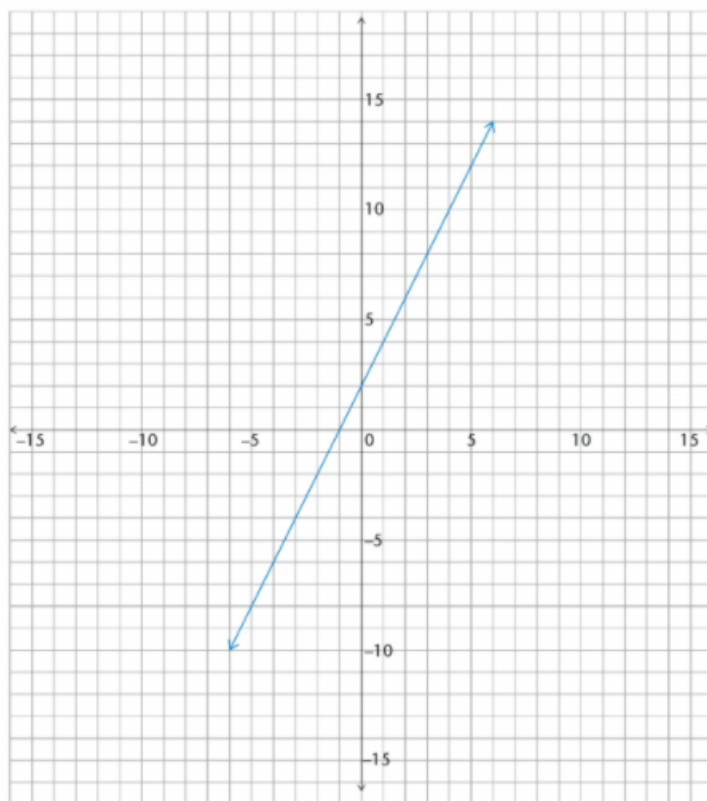


Figure 2:

2.3 Exercise 3

1. Represent the function, $3x + 4$, with the following:
 - 1.1 A flow diagram.
 - 1.2 A table of values for the set of integers from -5 to 5 .
 - 1.3 A graph
2. Represent the function, $2x - 5$, with the following:
 - 3.1 A flow diagram.
 - 3.2 A table of values for the set of integers from -5 to 5 .
 - 3.3 A graph
3. Represent the function, $\frac{1}{2}x + 2$, with the following:
 - 3.1 A flow diagram.
 - 3.2 A table of values for the set of integers from -5 to 5 .

3.3 A graph

4. Represent the function, $-3x + 4$, with the following:

4.1 A flow diagram.

4.2 A table of values for the set of integers from -5 to 5 .

4.3 A graph

5. Represent the function, $2.5x + 1.5$, with the following:

5.1 A flow diagram.

5.2 A table of values for the set of integers from -5 to 5 .

5.3 A graph

6. Represent the function, $0.2x + 1.4$, with the following:

6.1 A flow diagram.

6.2 A table of values for the set of integers from -5 to 5 .

6.3 A graph

7. Represent the function, $-2x - 4$, with the following:

7.1 A flow diagram.

7.2 A table of values for the set of integers from -5 to 5 .

7.3 A graph

3 ANSWERS

3.1 Exercise 1

1.1 For example, choose the number 4: $50 - (5 \times 4) = 30$ The answer will never be negative regardless of which number you choose from set A. If we choose the smallest number, 1, the answer is $50 - (5 \times 1) = 45$ If we choose the biggest number, 9, the answer is $50 - (5 \times 9) = 5$ Therefore, the answer is > 0 . The answer will always be positive

1.2 For example, choose the number 50: $50 - (5 \times 50) = -200$ The answer will always be negative regardless of which number you choose from set B. If we choose the smallest number, 20, the answer is $50 - (5 \times 20) = -50$ If we choose the biggest number, 90, the answer is $50 - (5 \times 10) = -400$ Therefore, the answer is < 0 The answer will always be negative

2.1 For example, where $x = 1$: $50 - (5 \times 1) = 45$.

45; 40; 35; 30; 25; 20; 15; 10; 5

2.2 $-50; -100; -150; -200; -250; -300; -350; -400$

3.1

Input numbers	1	2	3	4	5	6	7	8	9
Values of $50 - 5x$	45	40	35	30	25	20	15	10	5

3.2

Input numbers	20	30	40	50	60	70	80	90
Values of $50 - 5x$	-50	-100	-150	-200	-250	-300	-350	-400

4. 1 For example, if $n = 2$: $2 \times 2 + 1 = 5$. The set is: $5; 9; 13; 17; 21; \dots$ Note that the set of input numbers is continued, so we use three dots to show this.

4. 2 For example, if $x = 2$: $2 \times 2 - 1 = 3$ The set is: $3; 7; 11; 15; 19; \dots$

4. 3 For example, if $x = 2$: $2 \times 2 + 5 = 9$ The set is: $9; 13; 17; 21; 25; \dots$

4. 4 For example, if $x = 2$: $3 \times 2 + 1 = 7$ The set is: $7; 13; 19; 25; 31; \dots$

5. The output numbers will all be negative. The largest natural number smaller than 1 000 is 999. Therefore $999 - 1\ 000 = -1$. Any number smaller than 999 will also result in a negative output.

6. The biggest natural number smaller than 10 is 9, and the smallest is 1. $\frac{9}{10} + 10 = 10,9$ and $\frac{1}{10} + 10 = 10,1$. Therefore, the output numbers will all be mixed numbers or decimals between 10 and 11, for example, $10\frac{1}{5}; 10\frac{2}{5}; 10,7$ and so on.

7. They will all be whole numbers (not equal to 0), because the denominators are all factors of 30.

For example, if $x = \frac{1}{5}$: $30 \times \frac{1}{5} + 2 = 8$.

3.2 Exercise 2

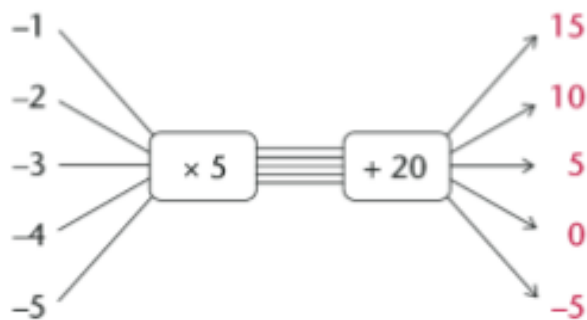


Figure 3:

1.

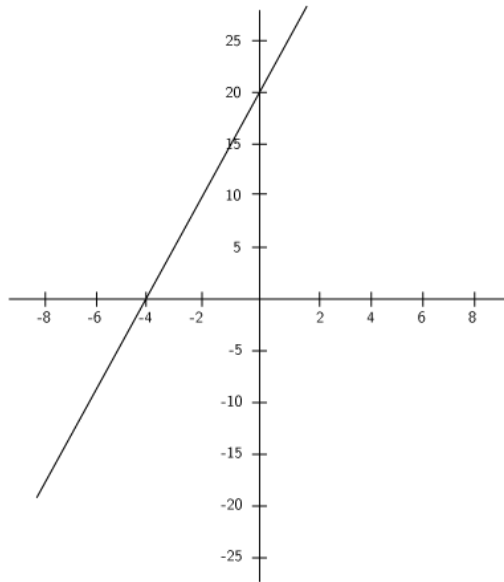


Figure 4:

2.

Input numbers	-1	-2	-3	-4	-5
Function values	15	10	5	0	-5

3.

4.

Input numbers	-5	-2	0	1	2
Function values	-8	-2	2	4	6

3.3 Exercise 3

1.1

1.2

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
$3x + 4$	-11	-8	-5	-2	1	4	7	10	13	16	19

1.3

2.1

2.2

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
$2x - 5$	-15	-13	-11	-9	-7	-5	-3	-1	1	3	5

2.3

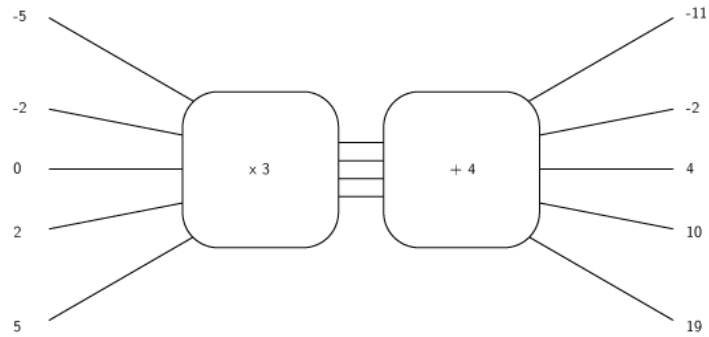


Figure 5:

3.1

3.2

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
$\frac{1}{2}x + 2$	$-\frac{1}{2}$	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$

3.3

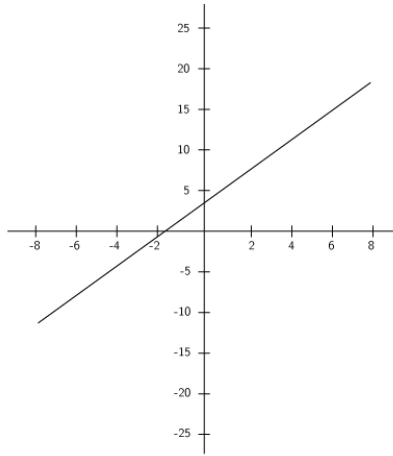


Figure 6:

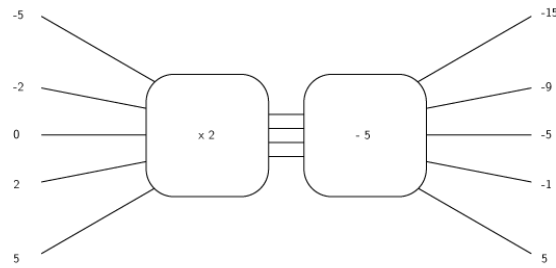


Figure 7:

4.1

4.2

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
$-3x + 4$	19	16	13	10	7	4	1	-2	-5	-8	-11

4.3

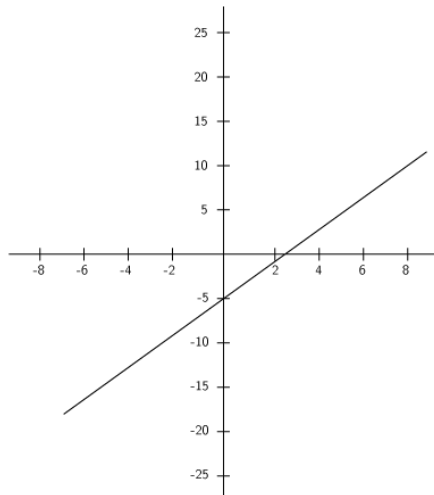


Figure 8:

5.1

5.2

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
$2,5x + 1,5$	-11	-8,5	-6	-3,5	-1	1,5	4	6,5	9	11,5	14

5.3

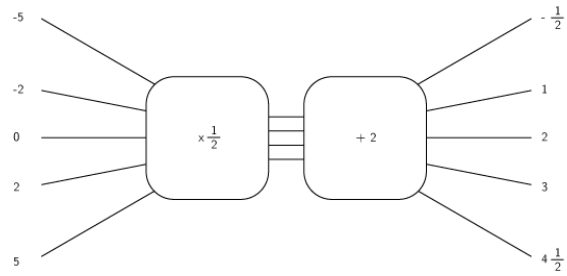


Figure 9:

6.1

6.2

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
$0, 2x + 1, 4$	0,4	0,6	0,8	1	1,2	1,4	1,6	1,8	2,0	2,2	2,4

6.3

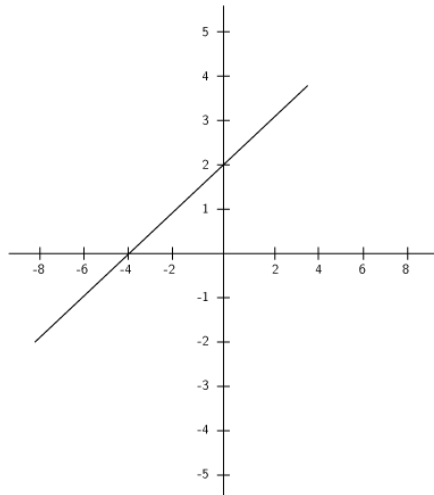


Figure 10:

7.1

7.2

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
$-2x - 4$	6	4	2	0	-2	-4	-6	-8	-10	-12	-14

7.3

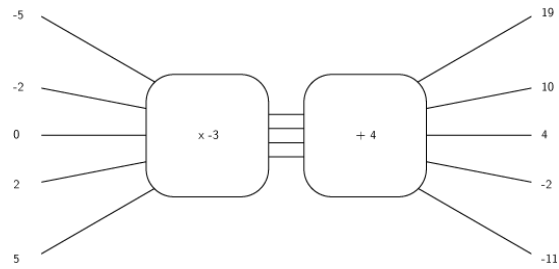


Figure 11:

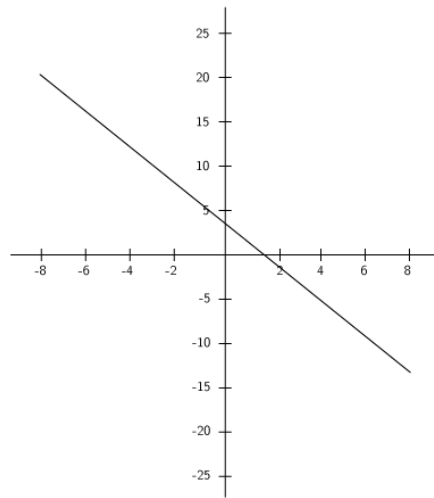


Figure 12:

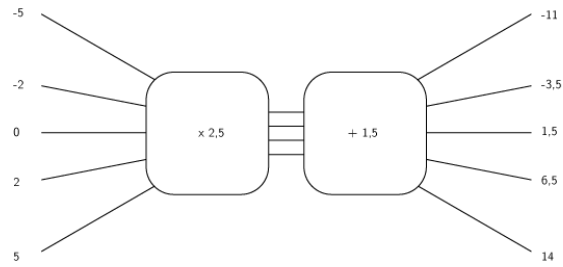


Figure 13:

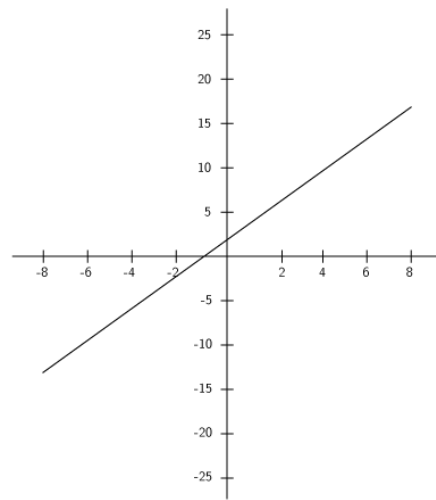


Figure 14:

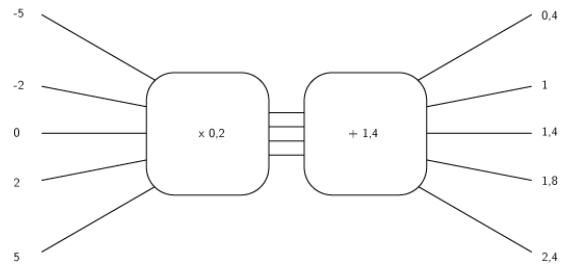


Figure 15:

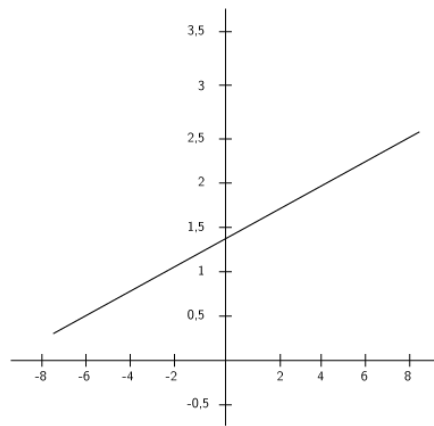


Figure 16:

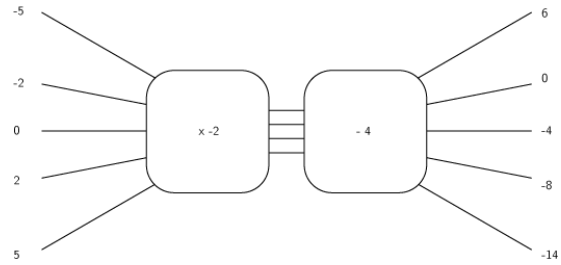


Figure 17:

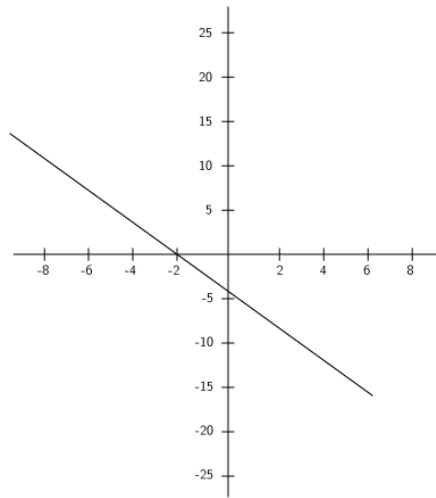


Figure 18: